NACA

RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Department of the Navy

RESISTANCE AND SPRAY CHARACTERISTICS OF A $\frac{1}{13}$-SCALE MODEL

OF THE CONSOLIDATED VULTEE SKATE 7 SEAPLANE -

TED NO. NACA DE 338

By

Robert E. McKann, Claude W. Coffee,
and Donald D. Arabian

Langley Aeronautical Laboratory
Langley Air Force Base, Va.

NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS
WASHINGTON

CONFIDENTIAL

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

for the

Bureau of Aeronautics, Department of the Navy

RESISTANCE AND SPRAY CHARACTERISTICS OF A $\frac{1}{13}$-SCALE MODEL

OF THE CONSOLIDATED VULTEE SKATE 7 SEAPLANE -

TED NO. NACA DE 338

By Robert E. McKann, Claude W. Coffee,
and Donald D. Arabian

SUMMARY

A model of a Consolidated Vultee Aircraft Corporation Skate 7 sea-
plane was tested in Langley tank no. 2. Resistance data, spray photo-
graphs, and underwater photographs are given in this report without
discussion.

INTRODUCTION

The Consolidated Vultee Aircraft Corporation has proposed a jet-
propelled type of seaplane (called the "Skate") in which the hull bottom
is merged into the wing resulting in an over-all depth of airplane much
less than used in conventional flying boats. Models of several different
configurations of the Skate type seaplane have been tested by Consoli-
dated Vultee using their open-water hydrodynamic test facilities.

At the request of the Bureau of Aeronautics, Department of the Navy,
a general evaluation of the hydrodynamic characteristics of the Skate 7
is being conducted in Langley tank no. 2.

In reference 1 the take-off stability characteristics of a $\frac{1}{13}$-scale
model of the Skate 7 were presented. The results obtained from the
investigation of the resistance characteristics of that model are given
without discussion in the present report. Spray and underwater photo-
graphs are also presented.

CONFIDENTIAL

MODEL AND APPARATUS

The $\frac{1}{13}$-scale powered model used in these tests was designed and
constructed by the Consolidated Vultee Aircraft Corporation. Photographs
of the model, designated Langley tank model 261, are shown in figure 1.
A photograph of the model on the towing apparatus is shown in figure 2.
The general arrangement and hull lines are shown in figures 3 and 4,
respectively. Pertinent dimensions are given in table I. The design
of the hull is discussed in references 2 and 3.

Jet thrust was simulated by supplying air from a reservoir on the
towing carriage to ejectors mounted one in each throat of the twin jets.
The hose carrying the air supply to the model jets were of gum rubber
and were wound with fine wire. An investigation of the decrement in
trim amplitude during oscillation of the model in the air with the hose
under the required pressure indicated that the restraint from the hose
would be small enough to be neglected in the tests.

From the preliminary test runs made with the model free to trim in
the air just above the water surface, it was found necessary to set the
stabilizer at 14° in order to obtain reasonable aerodynamic trim with
the air-flow conditions existing under the towing carriage.

PROCEDURE

The model weight was such that when the towing fittings were added
it was impractical to meet the design gross weight; therefore, the pre-
sent tests were made with a model gross weight corresponding to
36,710 pounds (full scale), equivalent to about 10-percent overload.

The resistance and trim of the complete model free to trim were
determined for a range of elevator deflection from 0° to -15° during
constant-speed runs with the center of gravity at $0.20\bar{c}$ using full thrust
(static thrust, 15,000 lb). The model jet thrust was measured at
constant speeds with the model in the air by measuring the force on the
model and its supporting gear with full thrust applied and deducting
from this measurement the drag of the model and its supporting gear
similarly measured in runs made without thrust applied. The air drag
of the towing gear was determined with the model removed. The model
thrust was greater than the total resistance of the model and gear
throughout these tests. Thus the resistance of the model, including its
air drag, was obtained by subtracting the balance reading and the air
drag of the towing gear from the measured thrust. Zero flap deflection

was used up to approximately hump speed (43 knots, full scale) and from this speed to take-off the flaps were set at 20° deflection.

The loads on the water for the trims and speeds of the resistance tests were obtained from a lift curve that was determined from the variation in take-off speed with trim observed in the take-off stability tests.

Photographs showing the spray at the jet inlet, on the flaps, and in the region of the tail were made during the resistance test runs. Underwater photographs of the flow in the vicinity of the step were made using a camera placed on the bottom of the towing tank and directed vertically up at the bottom of the model.

Photographs were also made of the spray near the jet inlets, on the flaps, and on the tail surfaces with the model at approximately 25- and 50-percent overload (41,720 and 50,060 lb).

RESULTS

All data are presented converted to full-scale values. The lower envelope of the resistance curves obtained for the range of elevator deflection tested is given in figure 5. This curve thus shows the minimum resistance obtainable by use of the elevators with the center of gravity located at $0.20\bar{c}$; the resistance, of course, includes the air drag of the hull, wing, and tail. The thrust curve determined from the model is also shown on this plot. No porpoising of greater than 2° oscillation in trim was encountered during the resistance tests. It will be noted that the resistance did not change greatly from the hump to nearly take-off speed. The trims and loads corresponding to the resistance curve are plotted in figure 6.

Photographs taken from the front quarter, rear quarter, and underside are shown in figure 7 from low speeds to planing speeds.

Spray photographs are shown in figure 8 of the model at 10-, 25-, and 50-percent overload at speeds from rest to hump speed.

Langley Aeronautical Laboratory
    National Advisory Committee for Aeronautics
        Langley Air Force Base, Va.

Robert E. McKann
Aeronautical Research Scientist

Claude W. Coffee
Aeronautical Research Scientist

Donald D. Arabian
Aeronautical Engineer

Approved: John B. Parkinson
    John B. Parkinson
    Chief of Hydrodynamics Division

DLMc

REFERENCES

1. McKann, Robert, Coffee, Claude W., and Arabian, Donald D.: Take-off
   Stability Characteristics of a $\frac{1}{13}$-Scale Model of the Consolidated
   Vultee Skate 7 Seaplane - TED No. NACA DE 338. NACA RM SL9D28a,
   Bur. Aero., 1949.

2. Caldwell, R. W.: Data and Specifications for a $\frac{1}{13}$ Scale Powered
   Tank Model of Skate 7. Rep. No. ZH-063, Consolidated Vultee
   Aircraft Corp., Jan. 20, 1949.

3. Caldwell, R. W.: Hydrodynamic Design of the Consolidated Vultee
   Seaplane Night Fighter. Rep. No. ZH-061, Consolidated Vultee
   Aircraft Corp., Dec. 1948.

TABLE I.- SKATE 7 - LANGLEY TANK MODEL 261

GENERAL DATA

	Full-size	Model
Hull:		
Gross load, lb	33,000	[a]14.88
Length of forebody to step point, in.	495	38.06
Length of afterbody, in.	345	26.55
Length, over-all, in.	984	75.7
Beam between spray strips, in.	109	8.39
Depth of step, in.	8.4	0.646
Dead-rise angle at step, deg	30	30
Sternpost angle, deg	6.74	6.74
Afterbody-keel angle, deg	5.5	5.5
Height of center of gravity above base line, in. .	58	4.46
Height of center line of jet inlet above		
base line, in.	78.12	6.01
Wing:		
Area, sq ft	960	5.69
Span, in.	744	57.2
Root chord, in.	266	20.4
Tip chord, in.	106	8.15
Mean aerodynamic chord, $\bar{c}$, in.	197.8	15.2
Leading edge of mean aerodynamic chord		
aft of bow, in.	387.5	29.8
Aspect ratio	4.0	4.0
Sweep of 25-percent-chord line, deg	35	35
Horizontal tail:		
Total area projected, sq ft	144	0.85
Span, in.	288	22.15
Dihedral, deg	10	10
Vertical tail:		
Total area, sq ft	117	0.69
Static thrust, lb	15,000	6.84

[a]Specific weight of tank no. 2 water in these tests was 63.2 lb/cu ft.
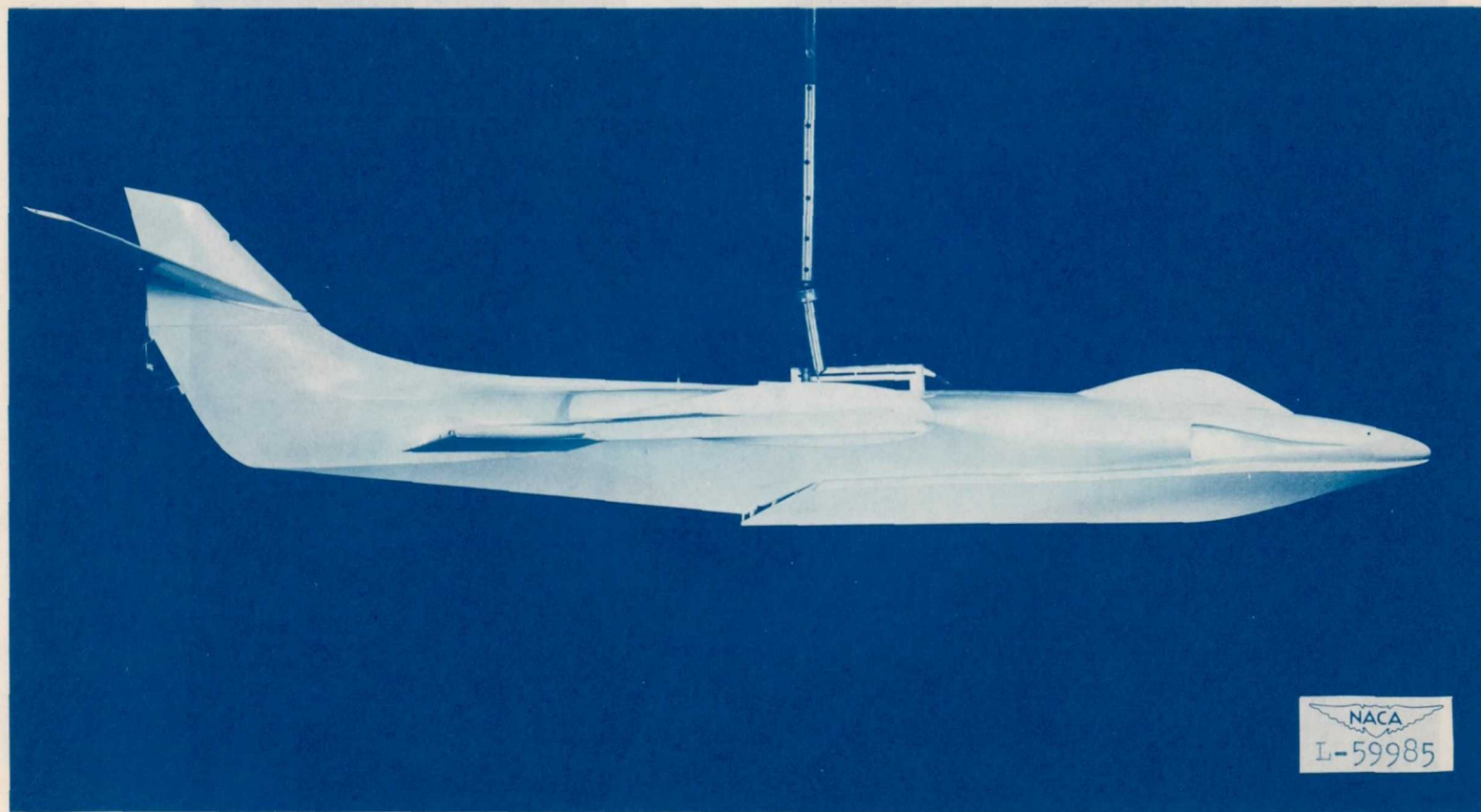
NACA

(a) Profile view.

Figure 1.— Langley tank model 261.

CONFIDENTIAL
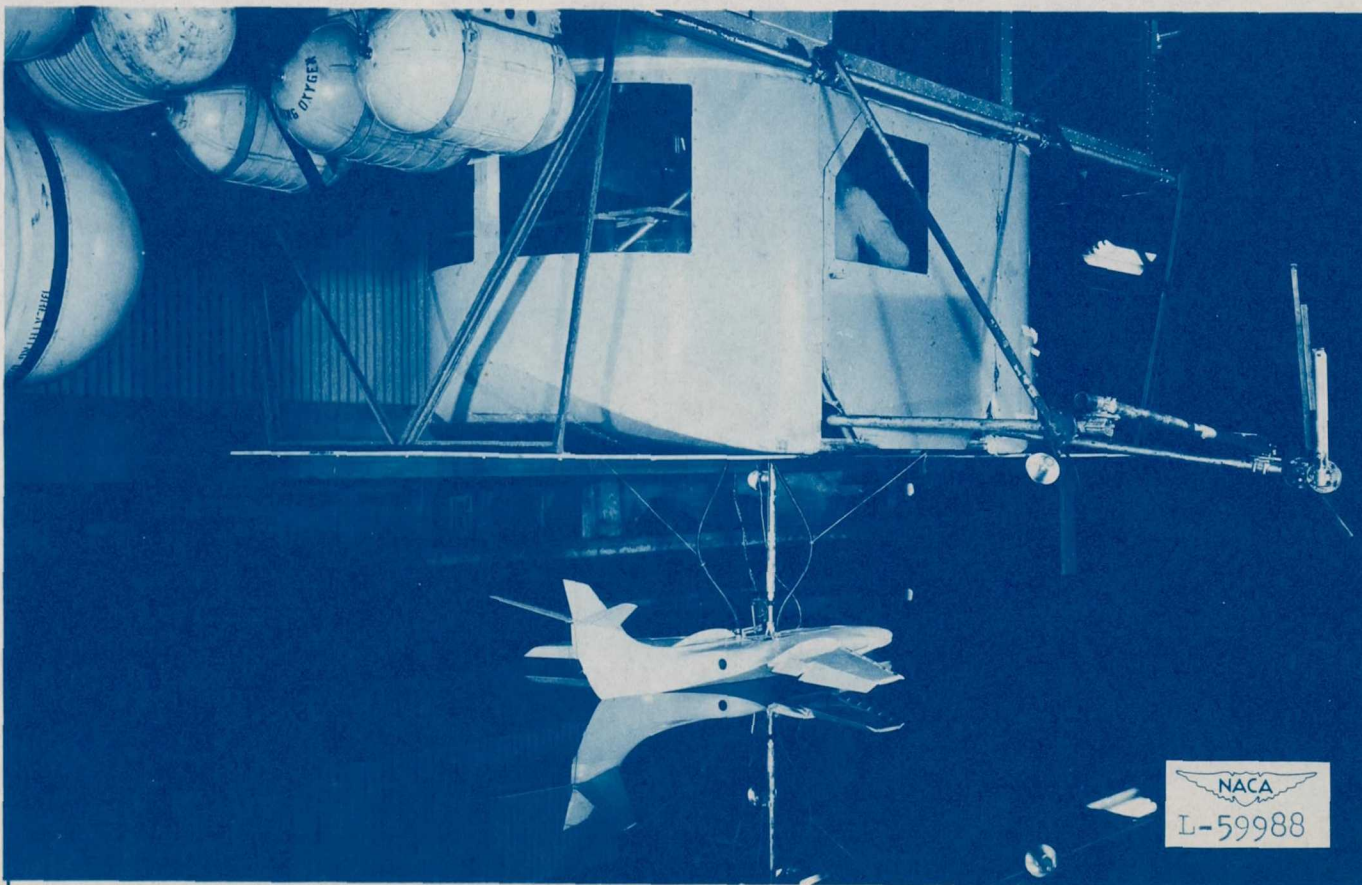
Figure 2.— Model 261 on towing apparatus.
CONFIDENTIAL

CONFIDENTIAL

.30c

.20c

9' 1"

35°

22' 0"

22' 0"

63' 2"

24' 0"

c̄ = 16' 0"

.25c

6' 6"

30°

10°

12' 9"

5' 6"

7' 7"

NACA

C.G. = .20 c̄

5' 6"

4' 10"

8.4"

5° 30'

17' 5"

Base line

34' 8"

41' 4"

70' 0"

82' 0"

CONFIDENTIAL
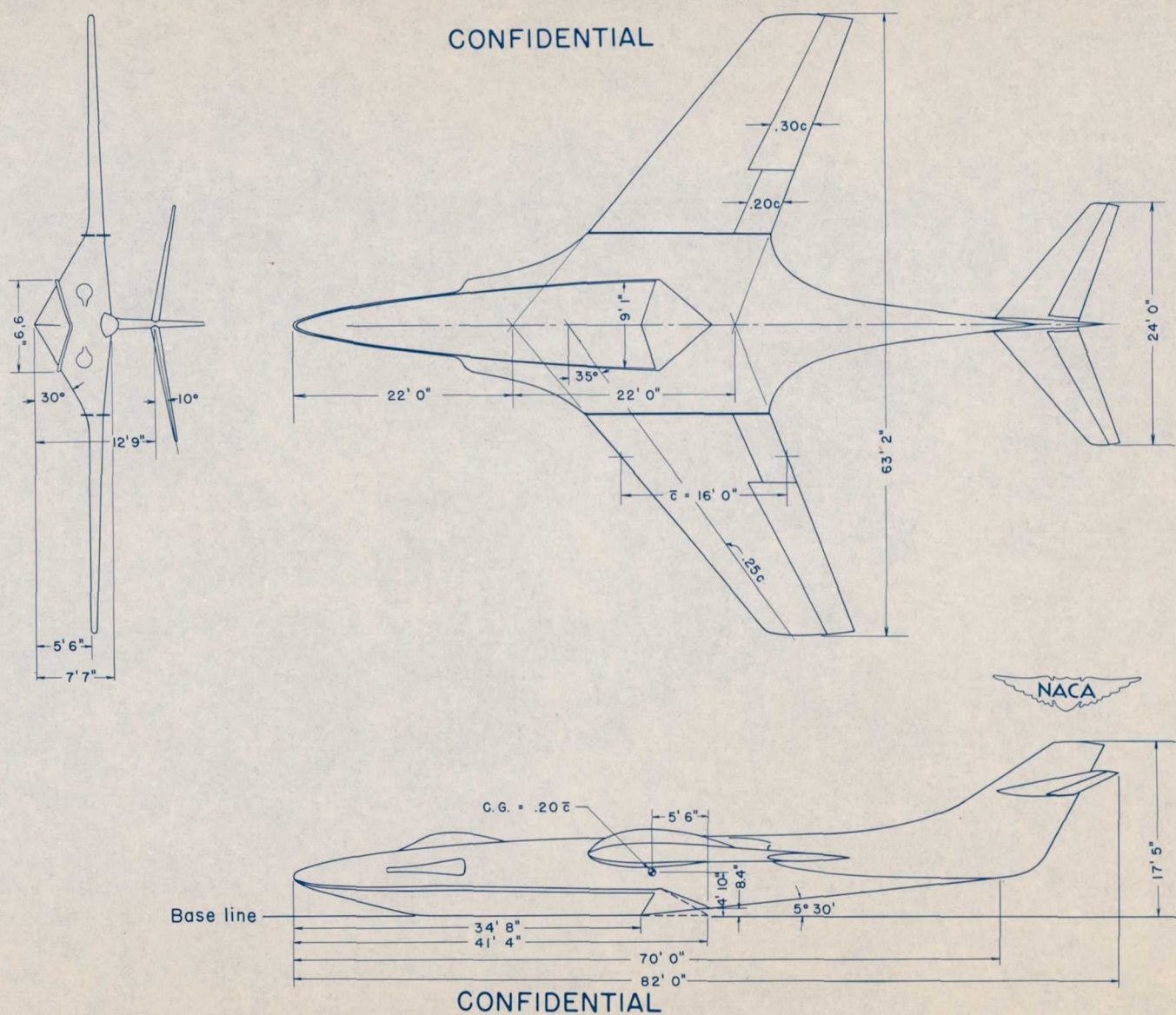
Figure 3.— General arrangement of Skate 7.

CONFIDENTIAL

Bottom view.

Sta. ① ② ③ ④ ⑤ ⑥ ⑦

CONFIDENTIAL
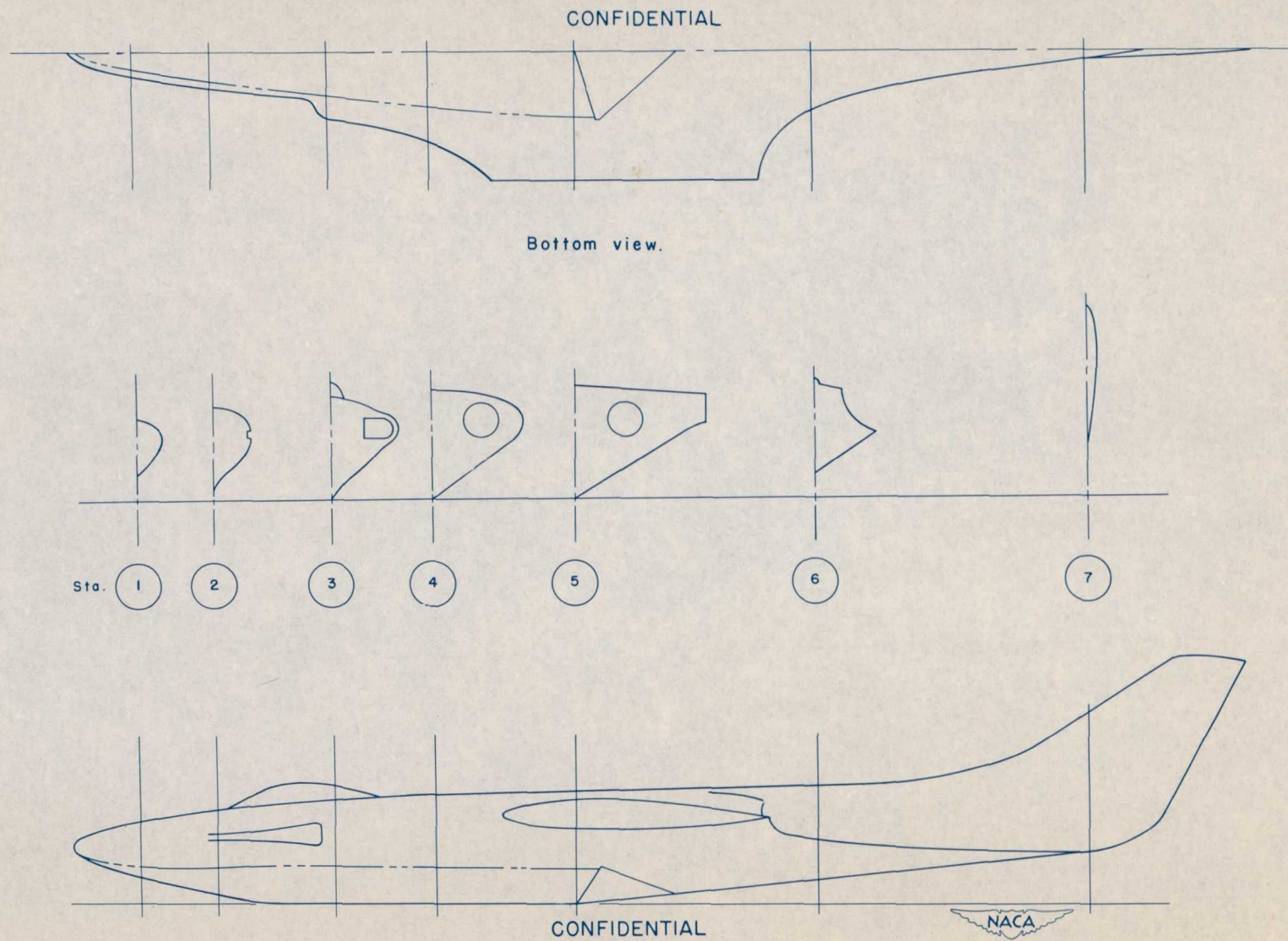
NACA

Figure 4.— Hull lines of Skate 7.
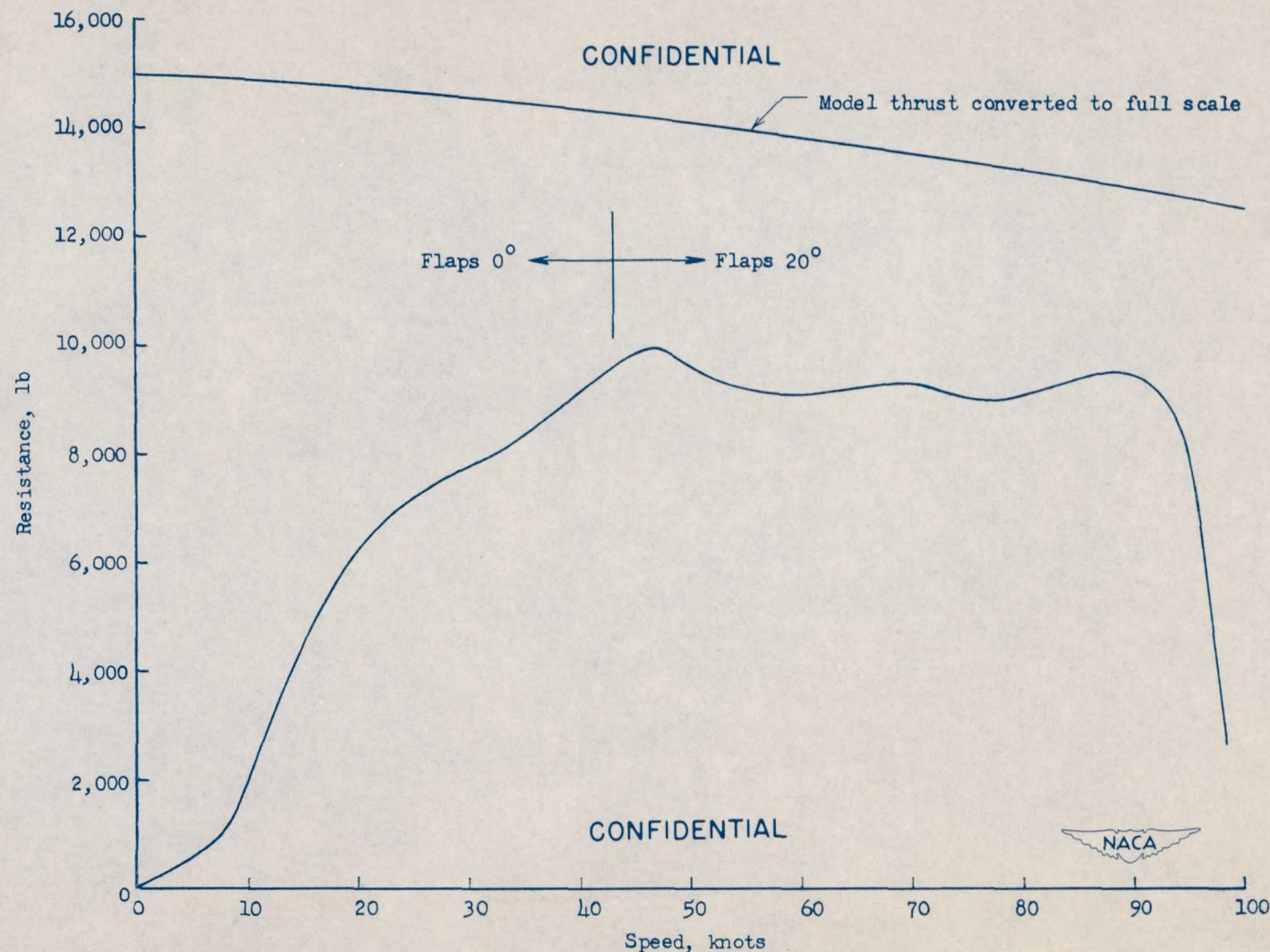
Figure 5.— Model 261. Minimum resistance in trim range obtainable by use of the elevators. Gross load, 36,710 pounds; full power; center of gravity, 0.20$\bar{c}$.
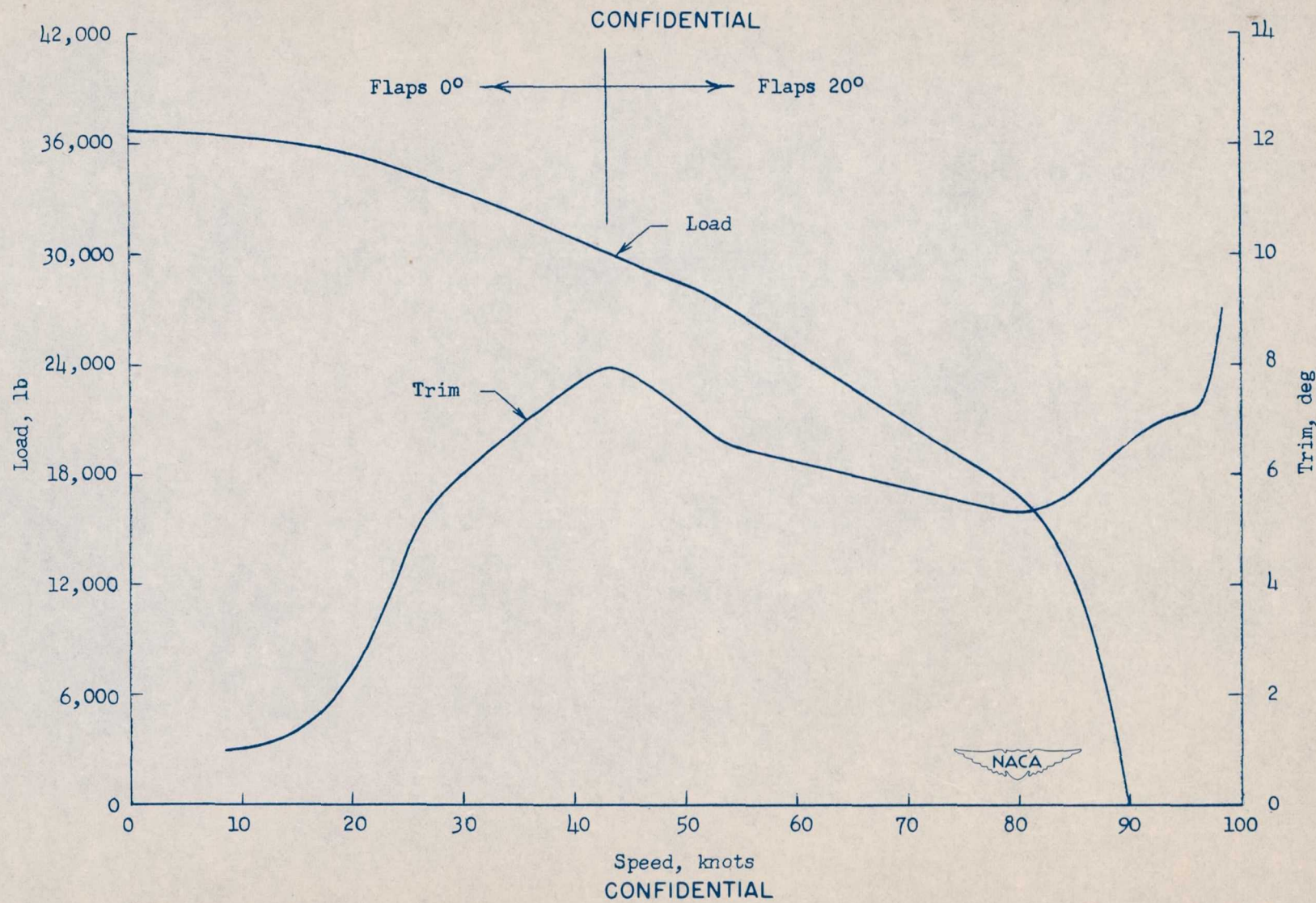
Figure 6.— Model 261. Trim and load for minimum resistance in trim range obtainable by use of the elevators. Full power; center of gravity, $0.20\bar{c}$.
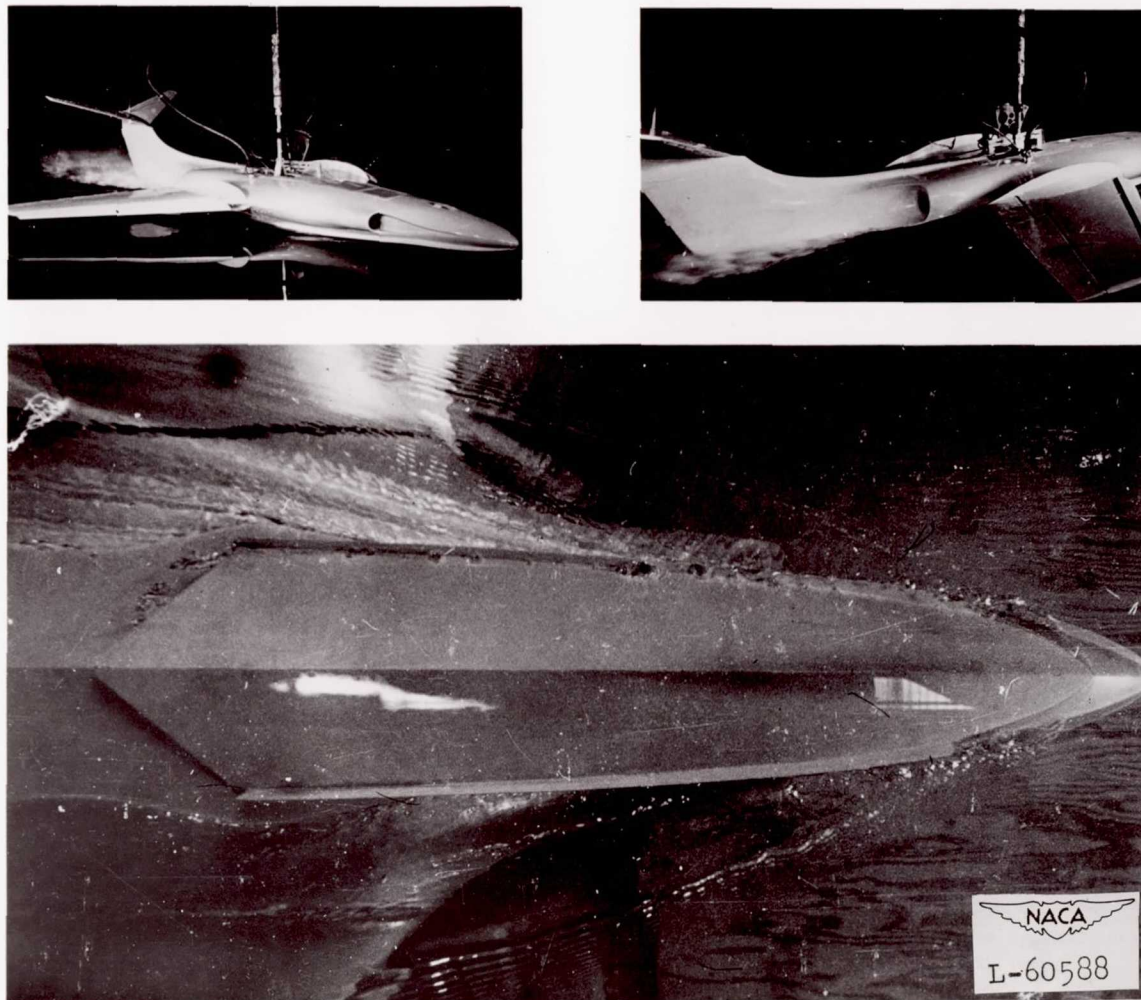
(a) Speed, 8.6 knots; trim, 1.8°.

Figure 7.— Model 261. Front quarter, rear quarter, and underwater photographs. Elevator deflection, 0°; center of gravity, 0.20c̄; full power; gross load, 36,710 pounds.

CONFIDENTIAL
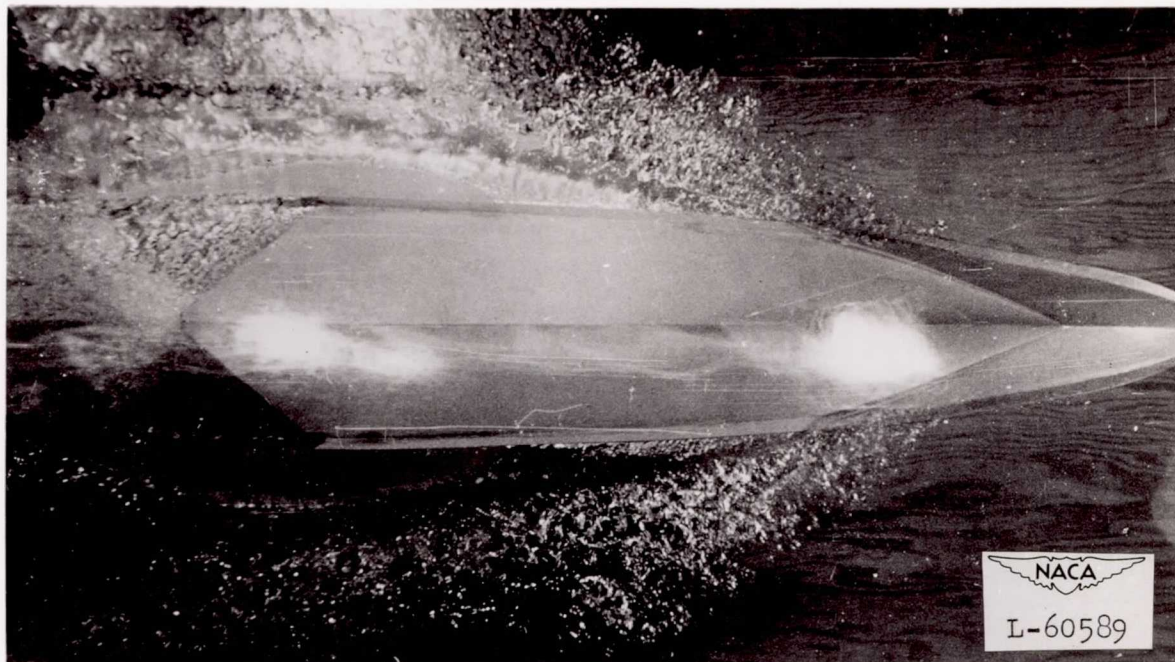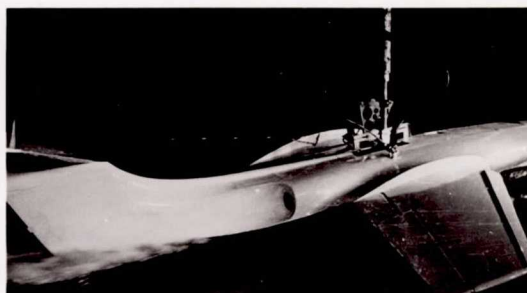
(b) Speed, 17.2 knots; trim 3.2°.

Figure 7.— Continued.

CONFIDENTIAL
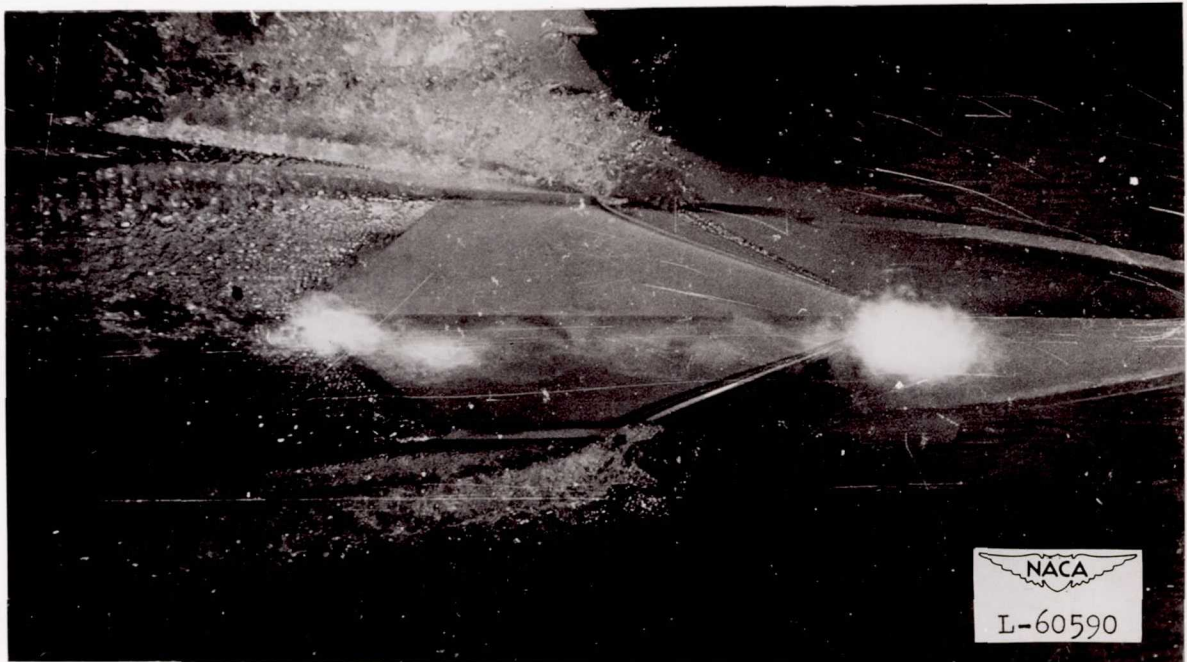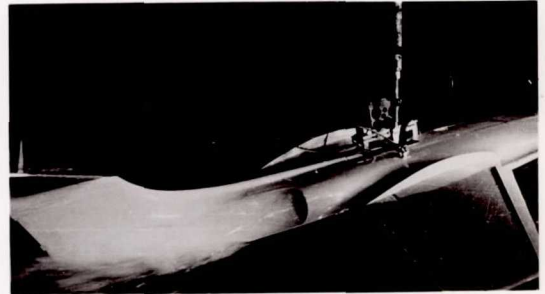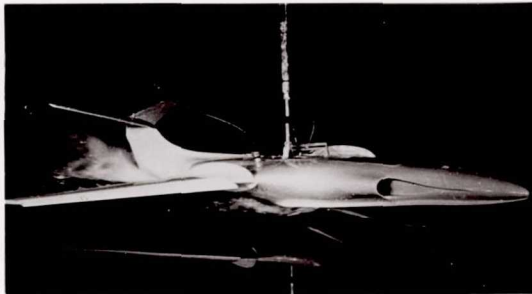
CONFIDENTIAL

(c) Speed, 25.7 knots; trim, 6.2°.

Figure 7.– Continued.

CONFIDENTIAL
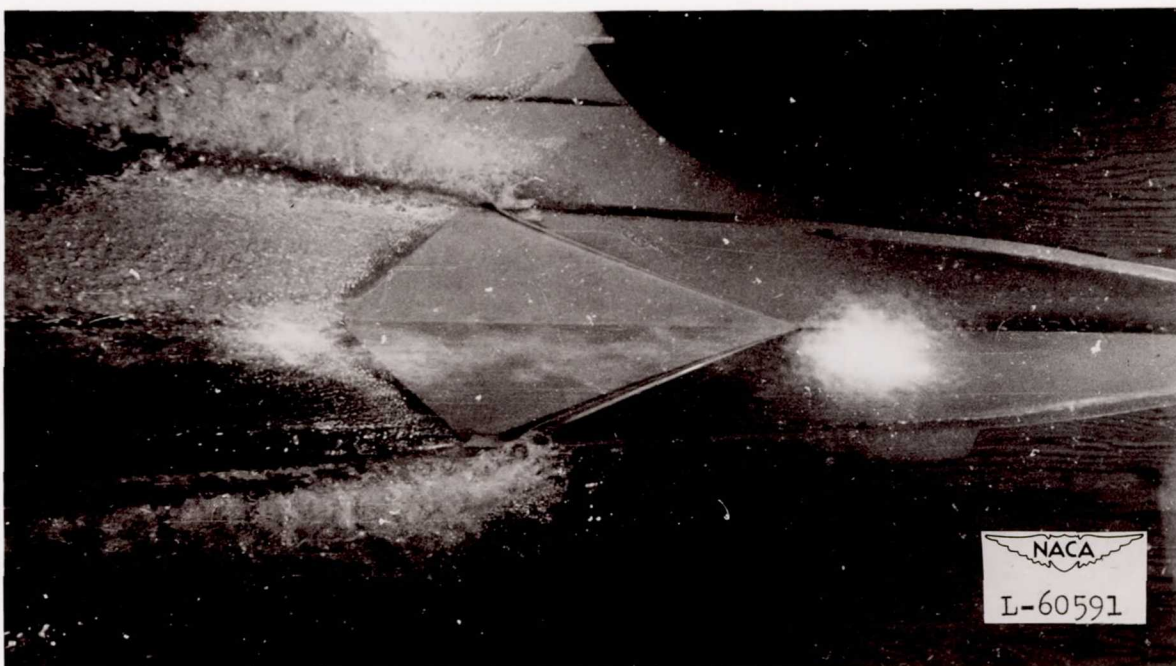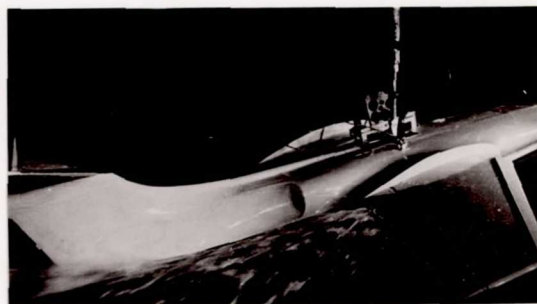
CONFIDENTIAL

(d) Speed, 34.2 knots; trim, 7.0°.

Figure 7.— Continued.
CONFIDENTIAL
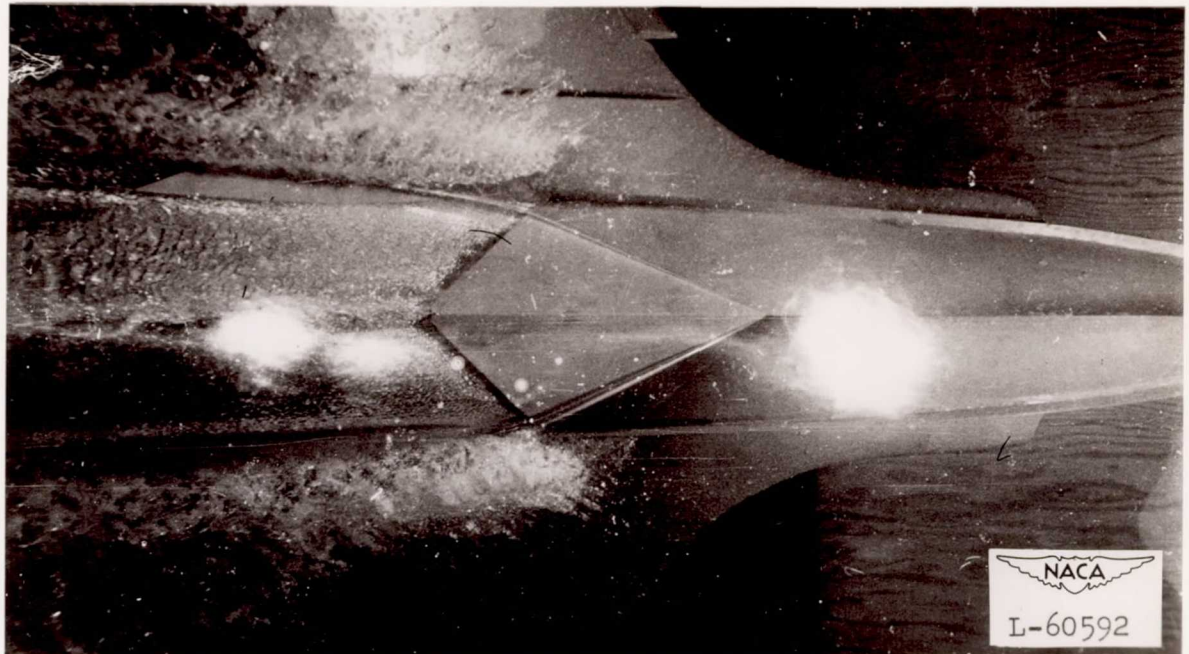
CONFIDENTIAL

(e) Speed, 42.8 knots; trim, 8.2°.

Figure 7.— Continued.
CONFIDENTIAL
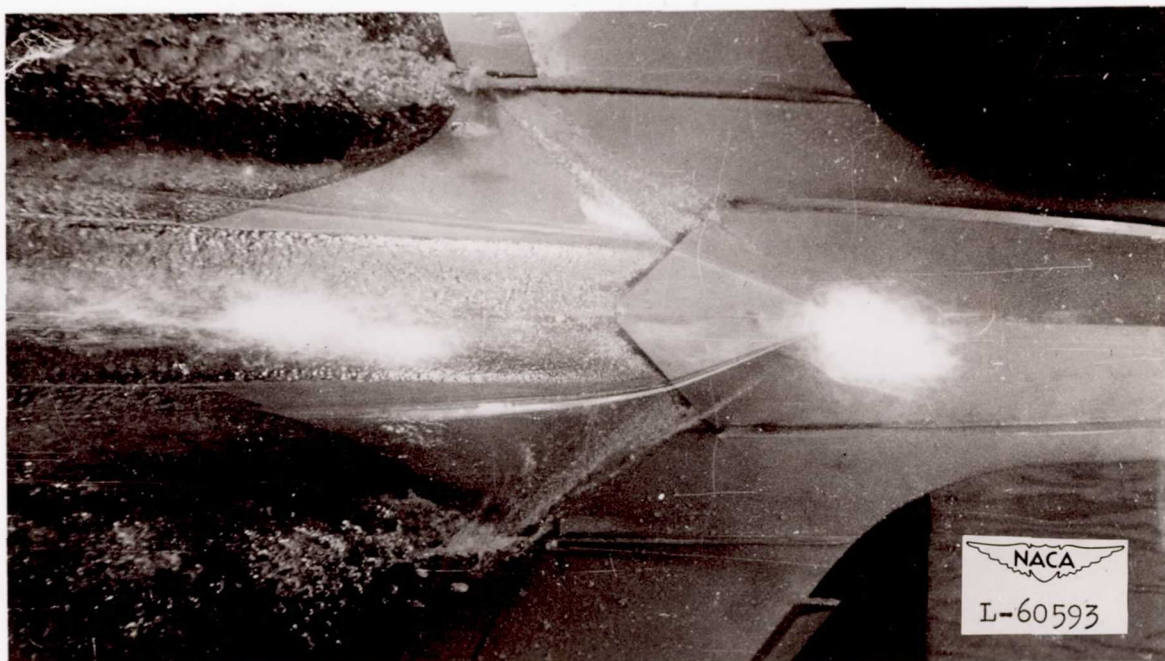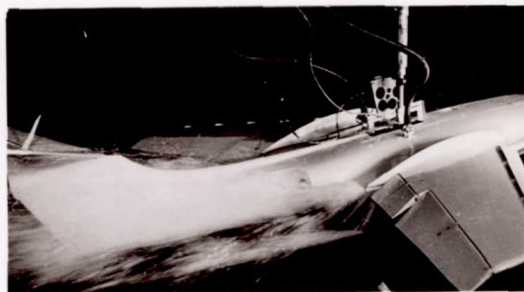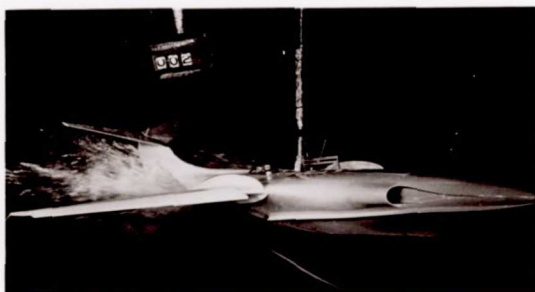
CONFIDENTIAL

(f) Speed, 59.9 knots; trim, 7.0°.

Figure 7.— Continued.
CONFIDENTIAL
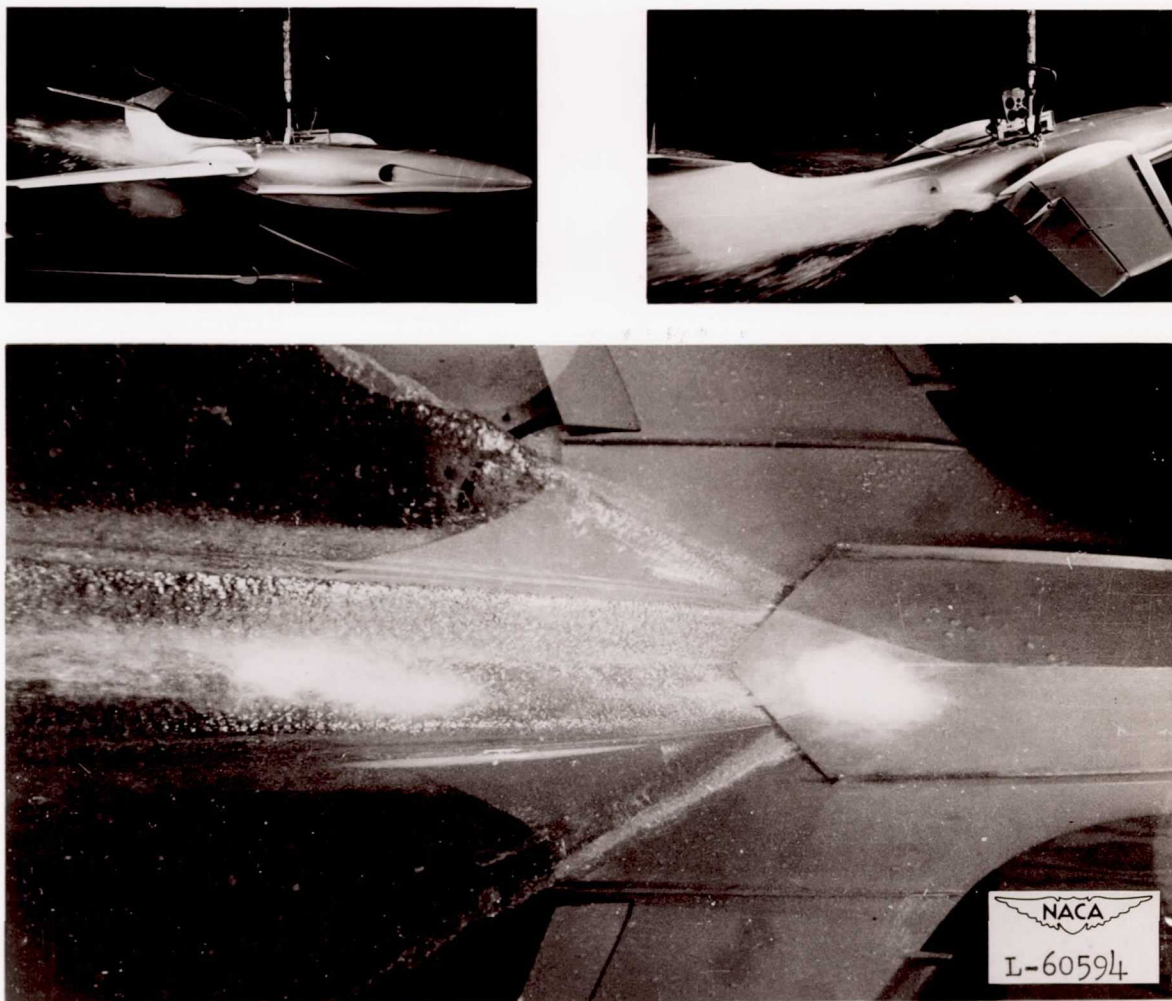
CONFIDENTIAL

(g) Speed, 77.0 knots; trim, 5.9°.

Figure 7.— Concluded.

CONFIDENTIAL
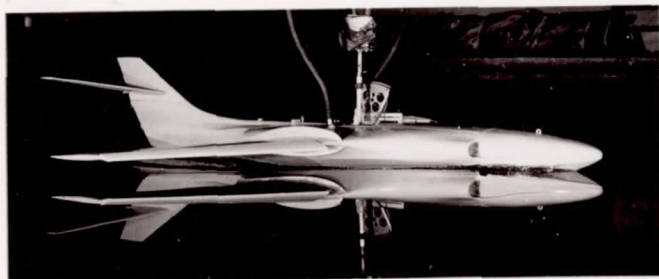
10-percent overload; trim, 2.3°

25-percent overload; trim, 2.8°
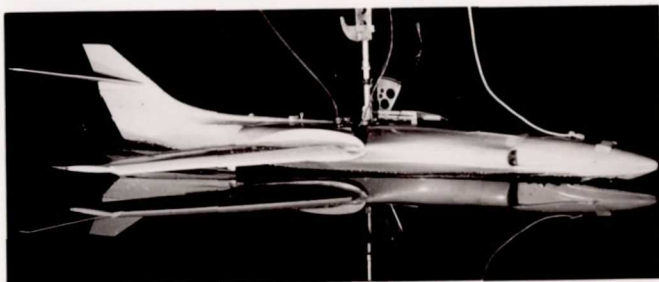

50-percent overload; trim, 3.5°

(a) Speed, 10.6 knots.
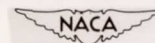
L-60582

Figure 8.— Model 261. Spray photographs of the model at 10-, 25-, and 50-percent overload. Elevator deflection, 0°; center of gravity, 0.20$\bar{c}$; full power.
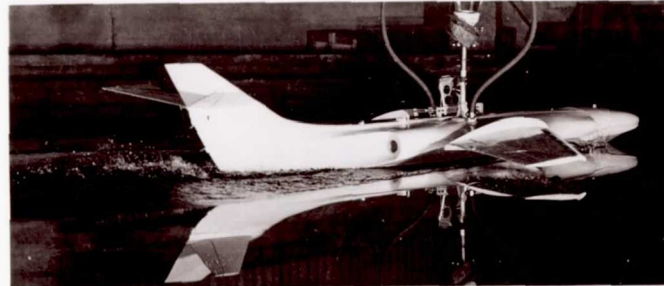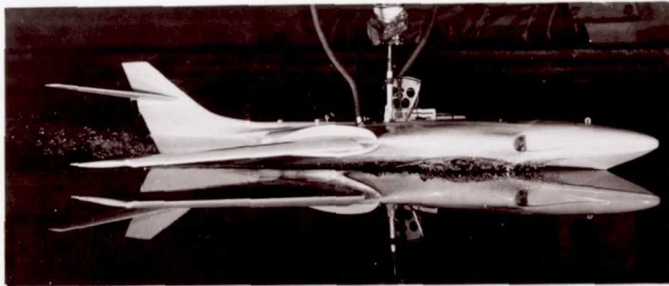
CONFIDENTIAL

10-percent overload; trim, 3.5° (spray in jet inlet)
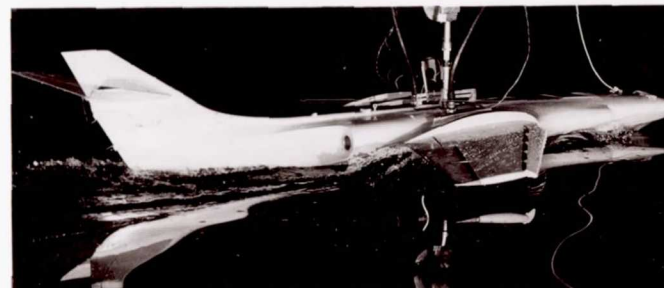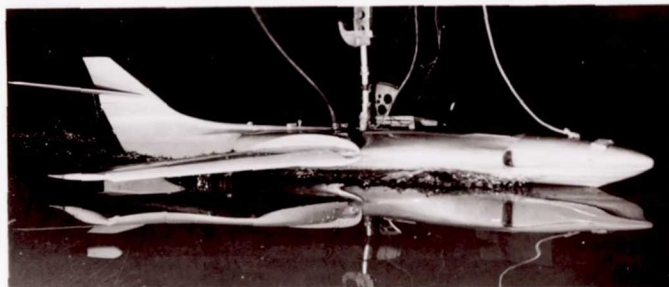
25-percent overload; trim, 4.3° (spray in jet inlet)
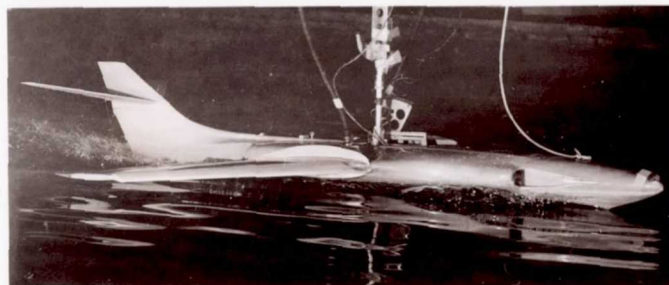
50-percent overload; trim, 5.2° (spray in jet inlet)

(b) Speed, 16.0 knots.

L-60583
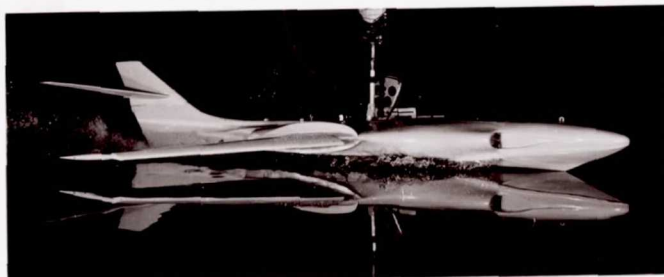
Figure 8.— Continued.

10 percent overload (no spray in jet inlet)
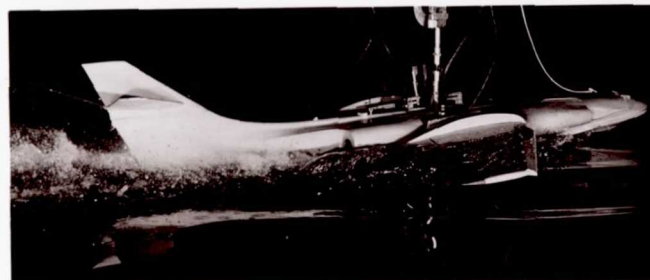
25 percent overload; trim, 5.5° (spray in jet inlet)
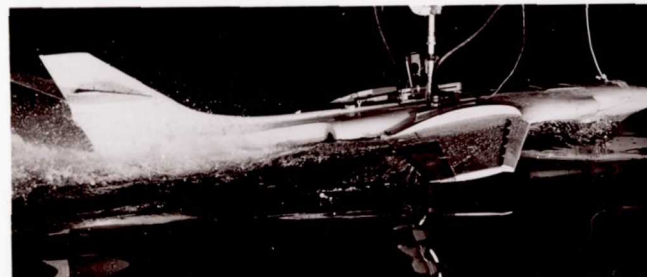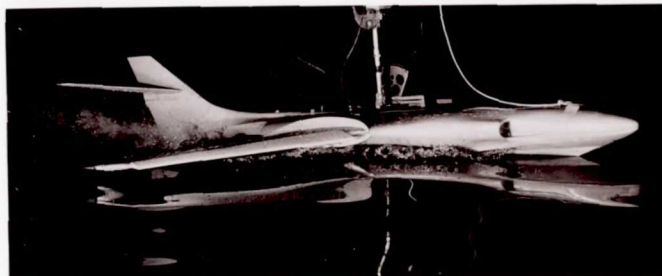
50 percent overload; trim, 6.9° (spray in jet inlet)

(c) Speed, 21.4 knots.

L-60584
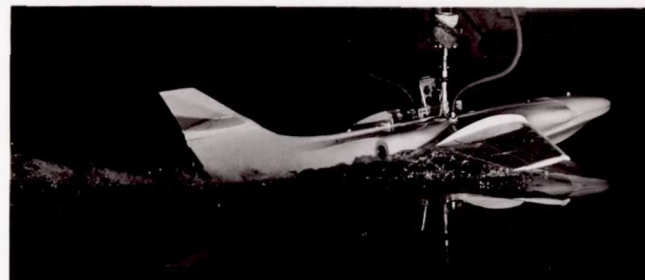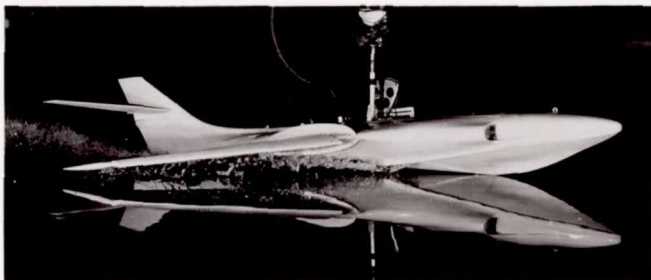
Figure 8.- Continued.

10-percent overload; trim, 5.3°

25-percent overload; trim, 6.9°
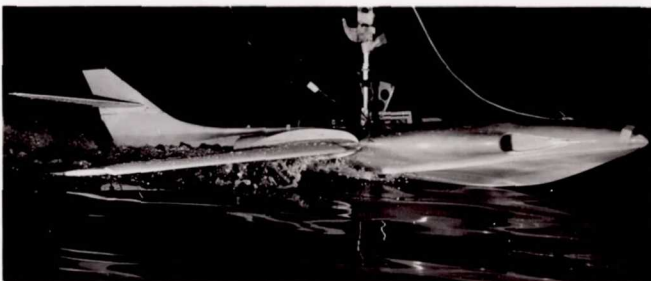
50-percent overload; trim, 8.9°

(d) Speed, 26.9 knots.

L-60585
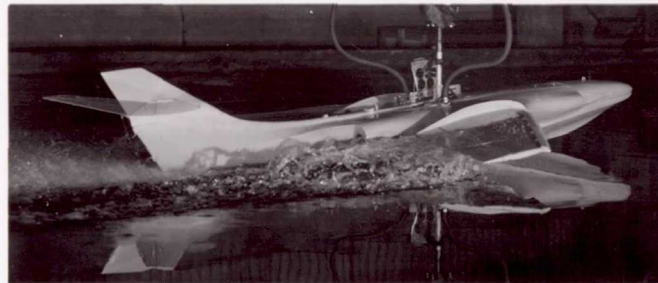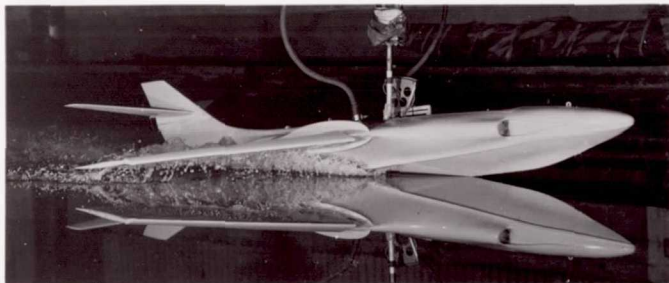
Figure 8.- Continued.

10-percent overload; trim, 7.3°
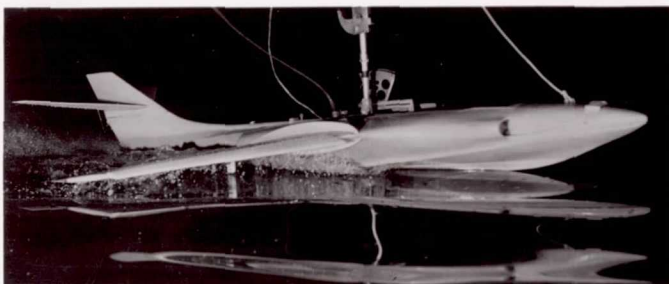
25-percent overload; trim, 8°
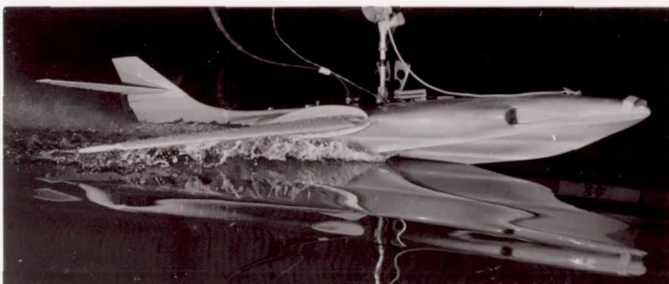

50-percent overload; trim, 10.1°

(e) Speed, 32.1 knots.

L-60586

Figure 8.— Continued.
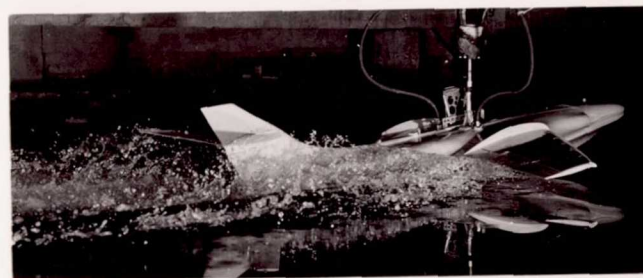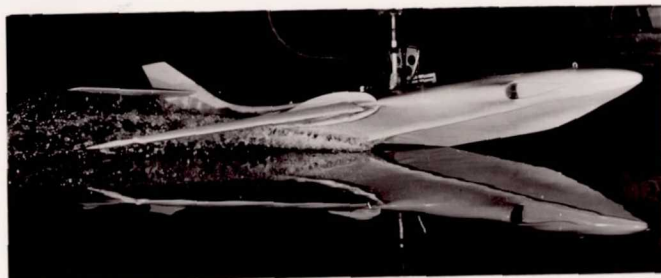
10-percent overload; trim, 8°
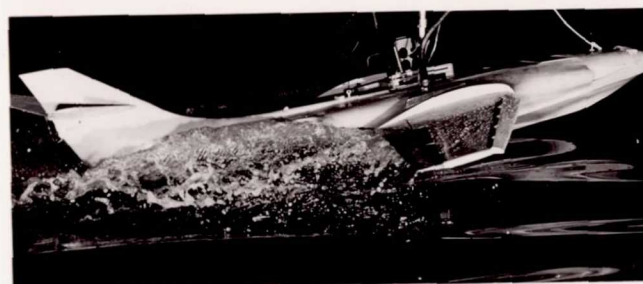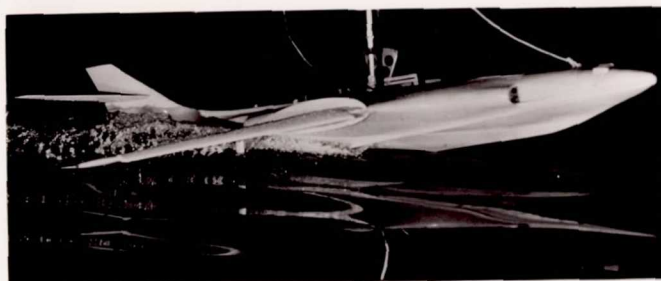
25-percent overload; trim, 9.2°

50-percent overload; porpoising

(f) Speed, 42.8 knots.

Figure 8.- Concluded.

L-60587